

**THE PUPAE OF THREE SPECIES IN *MINOMYIA* THEOBALD FROM NEPAL
AND A KEY TO THE KNOWN PUPAE OF THE GENUS IN THE ORIENTAL
AND AUSTRALASIAN REGIONS
(DIPTERA: CULICIDAE)**

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Abstract.—Four species of the genus *Mimomyia* are known from Nepal, *Mi. chamberlaini*, *Mi. luzonensis*, *Mi. hybrida* and *Mi. intermedia*. Complete descriptions and illustrations of the first three species are provided. A key to the known pupae of *Mimomyia* in the Oriental and Australasian regions is included.

Key Words: *Mimomyia*, pupae, Nepal

Four species of the genus *Mimomyia* Theobald are known from Nepal. The first to be reported was *Mi. (Etorleptomyia) luzonensis* (Ludlow) by Pradhan and Darsie (1989); then *Mi. (Mimomyia) chamberlaini* Ludlow and *Mi. (Mim.) hybrida* (Leicester) by Darsie and Pradhan (1990); and most recently *Mi. (Mim.) intermedia* Barraud, a single female in the Nepal collection by Darsie et al. (1992). Immature stages of the latter are unknown. One of the purposes of this study is to give a complete description of the pupae of the former three species.

Due to the size of the trumpets and forms of the paddles of the three pupae being described, only these structures have been illustrated and/or briefly described by Barraud (1934), Mattingly (1957, 1971), Delgado (1966, *Mi. chamberlaini* and *Mi. luzonensis*) and Baisas (1974, *Mi. luzonensis* only). Chen and Lien (1956) described the pupae of *Mi. luzonensis* and *Mi. chamberlaini*, as *Mi. metallica* (Leicester) in somewhat more detail; however, no complete description and illustration has previously been made. *Mimomyia chamberlaini* and *Mi. metallica* were considered by Mattingly

(1957) as the same polymorphic species, and Knight and Stone (1977) listed *Mi. metallica* as an infrasubspecies of *Mi. chamberlaini*. However, Lee et al. (1988) have raised *Mi. metallica* to a subspecies of *Mi. chamberlaini*.

The genus *Mimomyia* consists presently of three subgenera and 45 species. Of those, 32 are in Subsaharan Africa, mostly in the subgenera *Mimomyia* Theobald and *Ingramia* Edwards, while 14 occur in the Oriental and Australasian regions, 7 in the subgenus *Mimomyia* Theobald, 4 in the subgenus *Etorleptomyia* Theobald, and 3 in the subgenus *Ingramia* (Knight and Stone 1977, Knight 1978, White 1974). Pupae of 10 species, including the three treated here, have been adequately described and are included in the following key (Belkin 1962; Knight and Chamberlain 1948; Mattingly 1957, 1971).

METHODS AND MATERIALS

The methods are as described by Darsie (1998). Morphological nomenclature follows Harbach and Knight (1980). The pupae of *Mi. chamberlaini*, collected in Nepal,

are in the author's collection at the Florida Medical Entomology Laboratory, Vero Beach, FL, USA. For the other two species, no pupae from Nepal are available and those from Thailand, Malaysia, and the Philippines were borrowed from the National Museum of Natural History, Smithsonian Institution, Washington, DC. Abbreviations used in the descriptions are br meaning branches and Le and Pe meaning larval and pupal exuviae.

DESCRIPTIONS

Mimomyia (Mimomyia) chamberlaini
Ludlow
(Fig. 1)

Pupa.—Position and size of setae as figured, range and modal number of branches in Table 1. Abdomen 3.01–4.21, \bar{x} 3.86 mm, paddle 1.07–1.26, \bar{x} 1.14 mm.

Cephalothorax: Striped and mottled with darker brown patch pattern, those on mesothoracic wing match adult wing venation. Setae 1,3,5-CT very long and stout, usually double; 8-CT long, mostly with 5 br (4–6); trumpet very long, 1.53–2.09, \bar{x} 1.96 mm, index 12.7–17.0, \bar{x} 15.6, pinna in apical 0.16–0.23 \bar{x} 19.0, with normal opening for water surface respiration, tracheoid part 0.72–0.75 \bar{x} 0.73 of total length.

Abdomen: Segments I–III medium brown, IV–VIII with sublateral dark brown stripes. Seta 1-I subdendritic float seta with 13–38 br; 2,3-I long, single; 1-II long, rather stout, with 5–10 br; 1-III–VII and 5-IV–VII stout, with short and long br, 1-III,IV with 6–12 br, 1-V,VI with 4–11 br, 1-VII with 4–6 br, 3–VII absent; 5-IV–VI with 4–11 br, 5-VII with 3–7 br; 6-III–VI long, single, seldom double; 6-VII ventral, short, usually double (1–4); 9-VIII attached to a rather pointed, apicolateral process, short, usually 3, 4 br (1–4); female genital lobes with rather pointed prolongation apicolaterally, with medium-sized spicules.

Paddle: uniformly brown, except for large white area laterally in basal 0.58–0.74, some pupae (70%) also with smaller white area

medially; index 1.75–2.18, \bar{x} 1.99; midrib extending to apex; outer margin with large spine-like spicules in apical 0.2–0.44, tiny spicules on apex in Nepal specimens, bare point apically in Thai specimens; inner margin with similar large spicules in apical 0.12–0.22; seta 1-P short, single.

Material examined.—NEPAL: Lumbini District, Shivapur, IX-13-92, 1 ♀ LePe, IX-16-92, 1 ♀ LePe, ex *Eichornia* pond (Darsie and Courtney). MALAYSIA: Perak, Tanjong Tualang FR., 1968, 3 ♀ Pe, 2 ♂ Pe (811-15, 102, 104, 105, 113). PHILIPPINES: Mindoro Island, San Jose, II-25-45, 1 ♂ LePe, ex *Pistia* marsh (E.S. Ross).

Mimomyia (Etorleptomyia) luzonensis
Ludlow
(Fig. 2)

Pupa.—Position and size of setae as figured, range and modal number of branches in Table 2. Abdomen 3.61–3.87, \bar{x} 3.72 mm, paddle 1.0–1.04, \bar{x} 1.03 mm.

Cephalothorax: Uniformly light brown, setae 1,3-CT long, single, 3-CT stout; 5-CT medium long, usually double; 6-CT light in color, very long and stout, single; 8-CT unusually stout, single; trumpet extremely long, length 2.78–3.28, \bar{x} 3.03 mm; index 25.9–35.4 \bar{x} 32.4; tracheoid 2.14–2.63, \bar{x} 2.36 and pinna 0.13–0.16 \bar{x} 0.148 of total length.

Abdomen: Uniformly light tan; Seta 1-I medium long, single; 2,3-I long to very long, rather stout, single; 1-II long, stout, double, sometimes single; 1-III–VI long, stout, acuminate, usually 4 br, 1-VII very long, triple; 3–VII absent; 5-IV–VI long, stout, acuminate, usually triple, 5-VII 4,5 br; 6-II–VI long, single; 6-VII long, 4–6 br; 9-II–VII short, larger than usual, single; 9-VIII medium long or long, acuminate, 7–11 br; female genital lobe produced apicolaterally, with many large spines.

Paddle: light tan, linear, index 4.68–5.35 \bar{x} 4.98, midrib extending to apex, outer margin with spicules coarse in apical 0.5, finer basally; inner margin with coarse spicules to near base, seta 1-P short, thin, single.

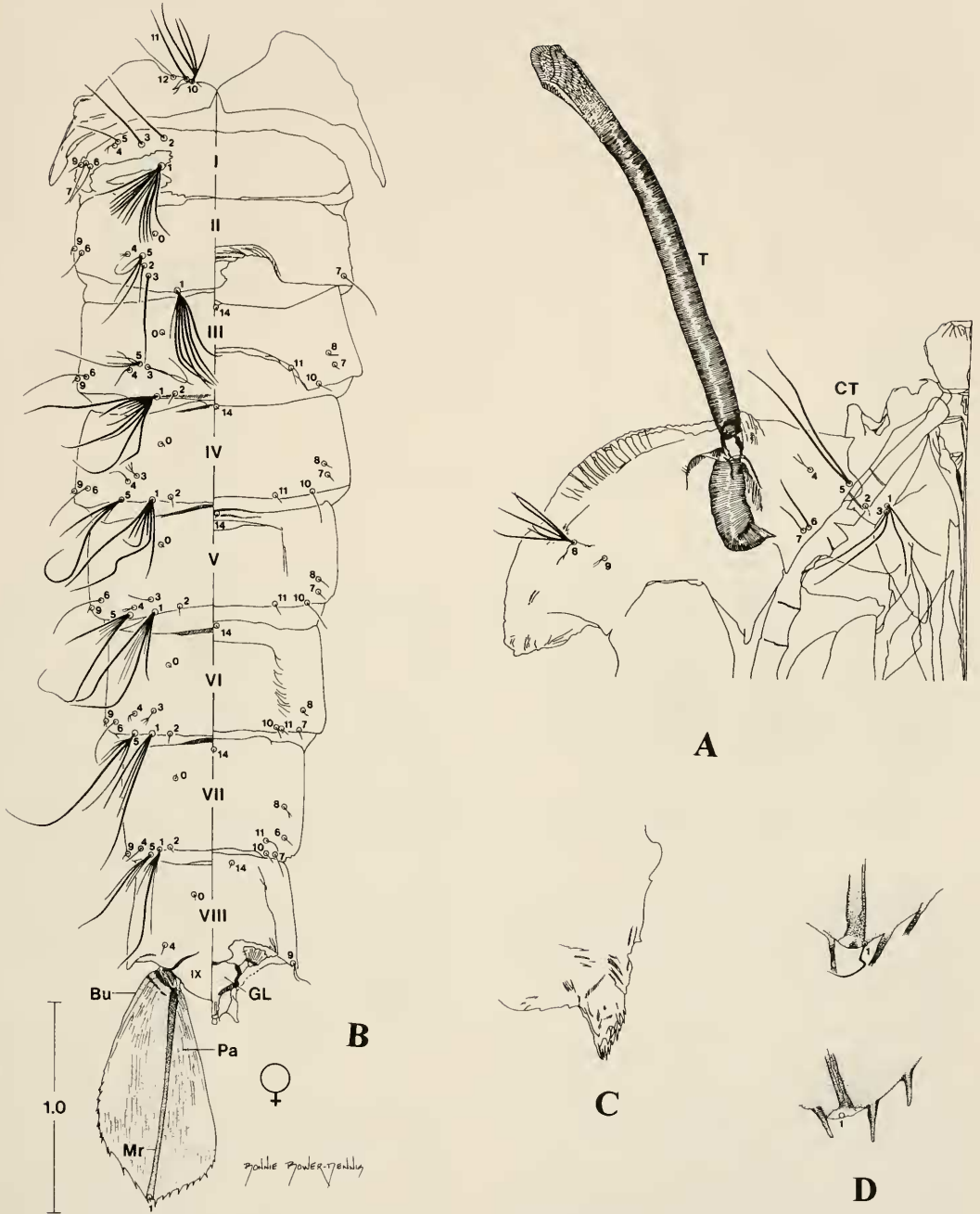


Fig. 1. Pupa of *Mimomyia (Mim.) chamberlaini*. A, Cephalothorax. B, Metanotum and abdomen. C, Lateral process of female genital lobe. D, Enlarged spicules on border of paddle, upper from Nepal, lower from Thailand. Abbreviations: Bu = external buttress; CT = cephalothorax, GL = genital lobe, Mr = midrib, Pa = paddle, T = respiratory trumpet; scale in mm.

Table 1. Setal branching of *Mimomyia chamberlaini* pupa.

Seta	Cephalo- thorax	Abdominal Segments							
		I	II	III	IV	V	VI	VII	VIII
0	—	—	1	1	1	1	1	1	1
1	2-4 (2) ¹	13-38 (?)	6-10 (6)	7-12 (10)	6-11 (8)	4-11 (7)	4-8 (8)	4-6 (?)	—
2	1-3 (2)	1	1	1	1	1	1	1	—
3	2-4 (2)	1	1,2 (1)	1-5 (2)	2-6 (3)	1-3 (2)	1-4 (3)	—	—
4	1-5 (3)	3-5 (4)	2-6 (3)	1	1	1-5 (1)	1-3 (1)	1-2 (1)	1-4 (1)
5	1-5 (4)	1-3 (1)	2-8 (4)	3-6 (4)	4-10 (?)	5-11 (9)	4-10 (?)	3-7 (4)	—
6	1	1-4 (2)	1-4 (1)	1	1	1,2 (1)	1,2 (1)	1-4 (2)	—
7	1	1,2 (1)	1,2 (1)	1	1,2 (1)	1,2 (1)	1,2 (1)	1,2 (1)	—
8	4-6 (5)	1,2 (1)	—	1-3 (1)	1-3 (1)	1-3 (1)	1-3 (1)	1-4 (3)	—
9	1-4 (2)	—	1	1	1	1	1	1	1-4 (3)
10	2-4 (4)	—	—	1	1,2 (1)	1,2 (1)	1	1-3 (1)	—
11	1-4 (1)	—	—	1	1	1	1	1,2 (1)	—
12	1,2 (1)	—	—	—	—	—	—	1	—
14	—	—	—	1	1	1	1	1	1

¹ Range followed in parenthesis by the mode.

Material examined.—THAILAND, Chonburi Province, Bang Lamung, Khao Mai Keao, X-8-63, 2 ♀, 3 ♂, Pe, ex pond on trackway (Kol, Vuth, Chmnong; Nepal: Sunsari District, Tarahara XI-25-87, 1 ♀, SPP, RFD; Sindhuli Garhi District, Bardia-agoth, IV-28-90, 2 ♀, SPP.

Mimomyia (Mimomyia) hybrida
(Leicester)
(Fig. 3)

Pupa.—Position and size of setae as figured, range and modal number of branches in Table 3. Abdomen 2.92-3.47, \bar{x} 3.27 mm, paddle 0.78-0.87, \bar{x} 0.83 mm.

Cephalothorax: Mottled with darker brown pattern, seta 1,3-CT very long, usually triple; 5-CT very long, 3-5 br; 6-CT very long, rather stout, single; 8-CT very long, with 4-6 br; trumpet length 1.46-1.92, \bar{x} 1.64 mm, index 9.0-13.2, \bar{x} 11.1; tracheoid 0.82-0.1.05, \bar{x} 0.93 and pinna 0.16-0.24 \bar{x} 0.20 of total length, pinna split into two spinulose processes, adapted for piercing plant tissue.

Abdomen: Uniformly light tan; seta 1-I float seta, 11-16 br; stout; 1-II long, rather stout, with 4-7 br; seta 1-III-VI with thin, long or very long br, 1-III with 4-9 br, 1-IV-VI with 2-5 br, 1-VII long, single, sel-

dom double; 2,3-I long, single, 2-I stout; 3-VII absent; 5-IV-VI with thin, moderately long or long br, 5-IV with 3-6 br, 5-V with 4 or 5 br, 5-VI with 2-4 br; 6-II-VI medium long, single, 6-VI rarely double; 6-VII ventral, short, single or double; 9-VIII short, usually double, when single, acuminate; female genital lobe with rounded projections apicolaterally, with numerous small spicules.

Paddle: ovoid, entirely light brown, bilobate apically, median lobe larger, index 1.64-1.92, \bar{x} 1.78 outer margin with coarse spicules in apical 0.20-0.29, inner margin with coarse spicules in apical 0.20-0.29, seta 1-P absent.

Material examined.—THAILAND, Chiangmai Province, Chiangmai, IX-30-52, 1 ♀, 1 ♂, LePe, ex pond (M300-A, M-300-1) (M. Rattanopradith); Nonthburi Province, Pak Kert, Ko Kret, IV-17-64, 1 ♀, LePe, ex ditch (Prajim). Nepal: Sunsari District, Tarahara, IX-X-85, 2 ♀; Morang District, Khanar, IX-X-85, 2 ♀; Sonapur, IX-X-85 2 ♀ (Burgess, unpublished data).

KEY TO THE KNOWN PUPAE OF THE GENUS
MIMOMYIA IN THE ORIENTAL AND
AUSTRALASIAN REGIONS

Partially adapted from Mattingly (1957)

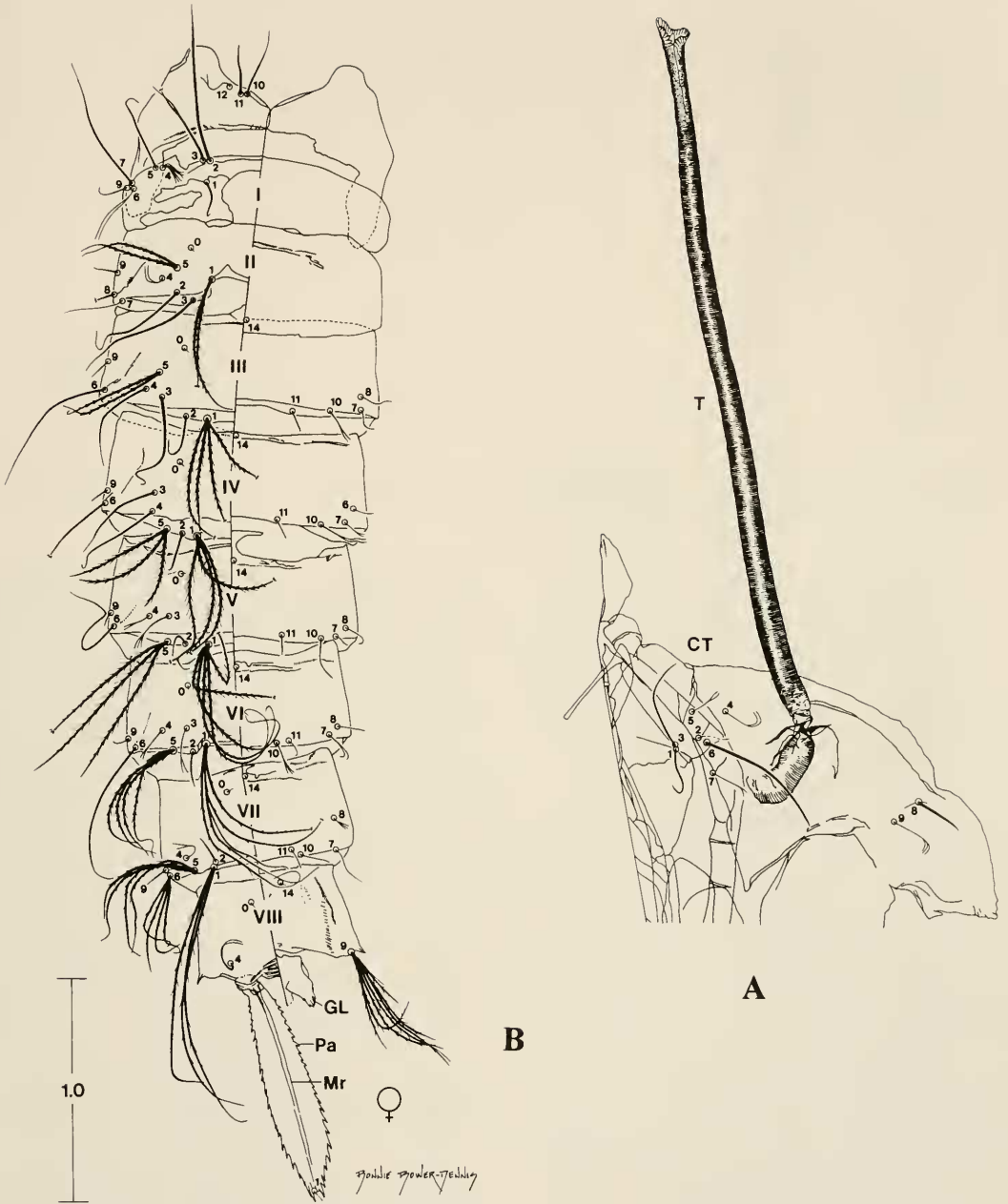


Fig. 2. Pupa of *Mimomyia (Eto.) luzonensis*. A, Cephalothorax. B, Metanotum and abdomen. For explanations of abbreviations, see Fig. 1.

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|---|----------|--|-------------------|
| <p>1. Seta 9-VIII very large with about 8 or more br, paddle at least 4× greatest width; seta 1-I small, single or bifid; trumpet length at least 20× width at middle</p> <p>— Seta 9-VIII small, with at most 3 br; paddle less than 3× greatest width; seta 1-I large</p> | <p>2</p> | <p>with numerous branches; trumpet < 20× width at middle (subg. <i>Mimomyia</i>)</p> <p>2(1). Paddle length at least 10X greatest width; seta 1,5-VII single or bifid; trumpet with tracheoid spiculose (subg. <i>Ingramia</i>)</p> <p>— Paddle length at most 8X greatest width;</p> | <p>7</p> <p>3</p> |
|---|----------|--|-------------------|

Table 2. Setal branching of *Mimomyia luzonensis* pupa.

Seta	Cephalo- thorax	Abdominal Segments								
		I	II	III	IV	V	VI	VII	VIII	
0	—	—	1	1	1	1	1	1	1	1
1	1	1	1,2 (2)	3,4 (4)	3,4 (4)	4,5 (4)	4-8 (5)	3	—	—
2	1	1	1	1	1	1	1	1	—	—
3	1	1	1	1	1,2 (1)	1-3 (3)	1-3 (2)	—	—	—
4	1-3 (2) ¹	2-6 (2)	1-3 (1)	1-4 (1)	2,3 (2)	1,2 (2)	1-3 (1)	1-3 (2)	1-4 (1)	—
5	2	1	1,2 (2)	2,3 (2)	3	3	3-5 (3)	4,5 (4)	—	—
6	1	1,2 (1)	1	1	1	1	1	4-6 (4)	—	—
7	1,2 (1)	1	1,2 (1)	1,2 (1)	1-3 (?)	1-3 (1)	1-3 (2)	1,2 (1)	—	—
8	1	—	—	1,2 (1)	1	1,2 (1)	1,2 (1)	1-3 (2)	—	—
9	1-3 (2)	1	1	1	1	1	1	1	—	7-10 (10)
10	1,2 (1)	—	—	1,2 (1)	1,2 (2)	1,2 (1)	1-5 (1)	1-3 (1)	—	—
11	1	—	—	1,2 (1)	1	1	1	1	—	—
12	1,2 (1)	—	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1	1

¹ Range of branching followed in parenthesis by the mode.

- seta 1,5-VII with at least 3 br, tracheoid of trumpet smooth (subg. *Etorleptomyia*) . . . 4
- 3(2). Seta 5-II,III about 0.75 length of seta 3-II-III *fusca* (Leicester)
- Seta 5-II,III 0.35 or less length of seta 3-II,III *deguznanae* (Mattingly)
- 4(2). Inner margin of paddle with small spinules in basal 0.5 5
- Inner margin of paddle with prominent spines 6
- 5(4). Seta 6-II, III, VII longer than following tergum *bougainvillensis* (Belkin)
- Seta 6-II, III, VII shorter than following tergum *elegans* (Taylor)
- 6(4). Setae 2,3-I subequal; seta 8-II present *solomonis* (Belkin)
- Seta 2-I 2.0 length of 3-I; seta 8-II absent *luzonensis* (Ludlow)
- 7(1). Trumpet with 2 pointed processes apically 8
- Trumpet without 2 pointed processes at apex 9
- 8(7). Setae 1,5-IV-VI with some branches longer than following tergum; paddle emarginate apically *hybrida* (Leicester)
- Setae 1,5-IV-VI shorter than following tergum; paddle rounded apically *gurneyi* (Belkin)
- 9(7). Lateral pale area in basal 0.58-0.74 of paddle, 0.5 of total length *chamberlaini* Ludlow
- Pale area in distal 0.5 of paddle, 0.3 of total length or less *aurea* (Leicester)

genus *Ingramia*, five species in the subgenus *Etorleptomyia*, and 9 in the subgenus *Mimomyia*., the latter appears to be the most primitive. That is because it has seta 8-CT a normal branched seta, seta 1-I a dendritic float seta, and paddle with indices of 1.6-2.18, similar to most other mosquito pupae. On the other hand, the subgenera *Etorleptomyia* and *Ingramia* have seta 8-CT stout, almost spike-like in most species, seta 1-I a single seta, and the paddles linear in shape with indices of 4.5-20. All subgenera have long tracheoid respiratory trumpets; however, those of *Mimomyia* have indices of varying from, 9.0-17.0, while those of the other two subgenera have indices of 25-50. Contrarily, seta 9-VIII is greatly reduced in the subgenus *Mimomyia*, with 2-5 branches, while it is fully developed in the other two with 8-22 branches. All in all, pupal evidence supports the evolution of *Etorleptomyia* and *Ingramia* at a later time than *Mimomyia*. These observations also consider the work of Grjebine (1986) on the Ficalbiini of Madagascar.

COMPARATIVE MORPHOLOGY OF SUBGENERA OF *MIMOMYIA* BASED ON PUPAL CHARACTERS

Based on evidence found in the descriptions of the pupae of 19 species in the sub-

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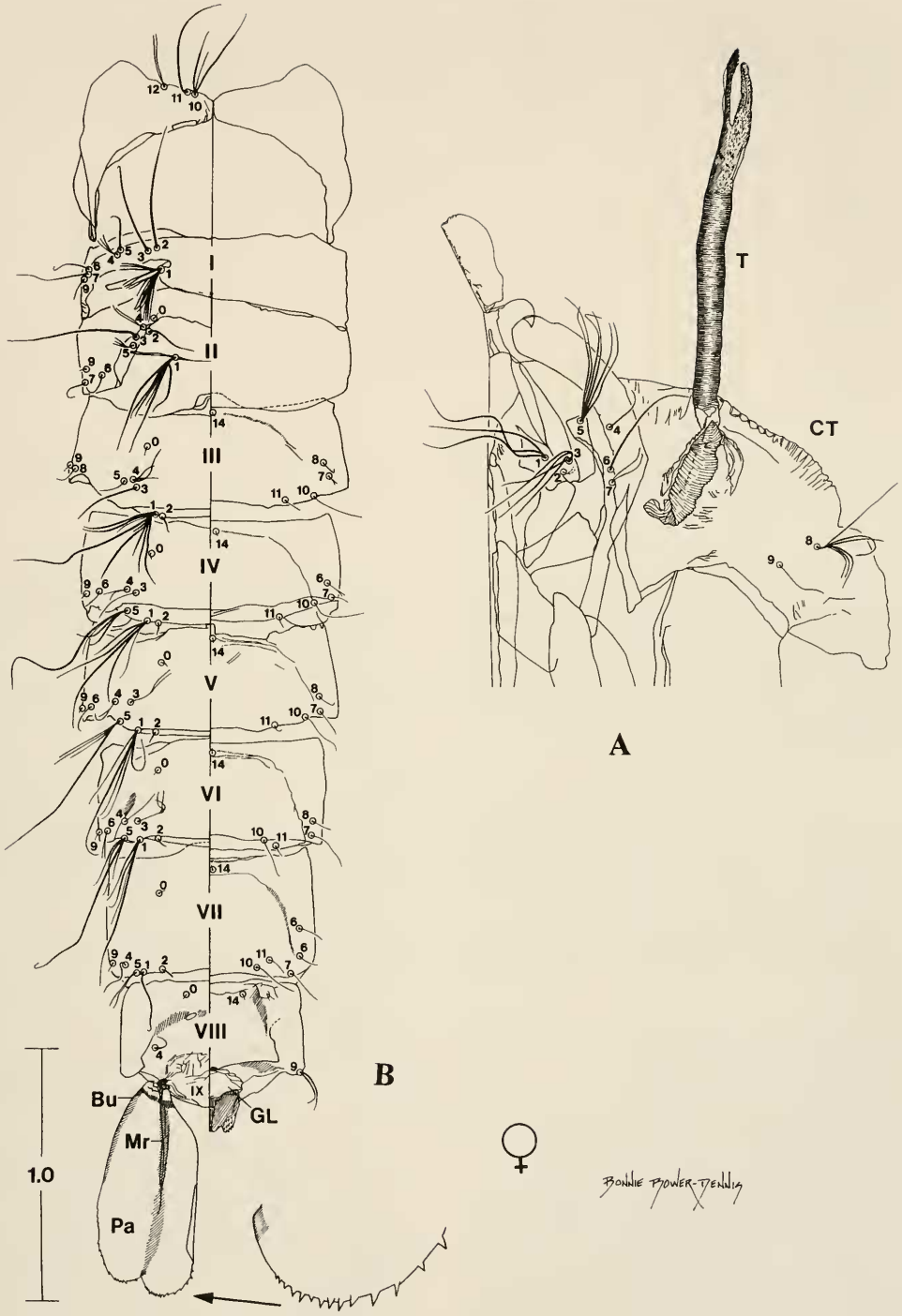


Fig. 3. Pupa of *Mimomyia (Mim.) hybrida*. A, Cephalothorax. B, Metanotum and abdomen. For explanation of abbreviations, see Fig. 1.

Table 3. Setal branching of *Mimomyia hybrida* pupa.

Seta	Cephalo- thorax	Abdominal Segments							
		I	II	III	IV	V	VI	VII	VIII
0	—	1	1	1	1	1	1	1	1
1	1-3 (3) ¹	11-16 (?)	4-7 (5)	4-9 (5)	2-5 (3)	2-5 (4)	2-4 (4)	1,2 (1)	—
2	2	1	1	1	1	1	1	1,2 (1)	—
3	1-4 (3)	1	1	1,2 (1)	1-3 (1)	2,3 (2)	1-3 (2)	—	—
4	1-4 (3)	2-4 (3)	1-4 (2)	3,4 (3)	2	2	1,2 (2)	1,2 (1)	1-3 (1)
5	3-6 (5)	1	2,3 (3)	1,2 (1)	3-6 (?)	4,5 (4)	2-4 (3)	1,2 (2)	—
6	1	1	1	1	1	1	1,2 (1)	1,2 (1)	—
7	1-3 (2)	1	1	1,2 (1)	1,2 (1)	1-4 (1)	1	1	—
8	4-6 (5)	—	—	1,2 (1)	1,2 (1)	1,2 (1)	1,2 (1)	1,2 (1)	—
9	1-3 (1)	1	1	1	1	1	1	1	1,2 (2)
10	2,3 (2)	—	—	1	1	1,2 (1)	1	1	—
11	1,2 (1)	—	—	1	1	1	1	1	—
12	1,2 (1)	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1

¹ Range followed in parenthesis by the mode.

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